IN THE CLAIMS

This listing of the claim will replace all prior versions and listings of claim in the present application.

Listing of Claims

1. (currently amended)A method for implementing an extensible network-attached secondary storage ~~operable with one or more of first~~in a system including a plurality of computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said method comprising the steps of:

executing at least one ~~or more~~ of a plurality of application programs on ~~said~~ a first computer;

wherein ~~providing~~ said secondary storage apparatus ~~with~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source,

wherein said secondary storage ~~including~~ stores therein a plurality of storage units which includes at least ~~(blocks) for storing~~ one ~~or more of~~ application data ~~(object)~~ used by said application programs,

wherein said secondary storage apparatus ~~providing~~ provides said first computer with a block-based I/O function and an object-based I/O function;

receiving in said secondary storage apparatus, from the first computer or a second computer different from the first computer an ~~receiving a program module~~ (object access module~~)~~ that implements the object-based I/O function by using the block-based I/O function ~~from the first computer or a second computer different from the first computer~~; and

receiving, said secondary apparatus from the first computer, an ~~receiving~~ object-based I/O request for said ~~object~~ application data ~~from said first computer to perform~~ and performing said object-based I/O ~~of the~~ request by executing said object access module.

2. (currently amended)A method for implementing an extensible network-attached secondary storage according to claim 1, wherein~~:~~ said object access module obtains ~~the~~ a data value or location of data in ~~the block~~ a storage unit corresponding to a specification, which is either an object, an object offset, an object offset size, or an object tag ~~(~~specifying the type of data to be retrieved~~)~~.

3. (currently amended)A method for implementing an extensible network-attached secondary storage ~~operable with one or more of first~~in a system including a plurality of computers, at one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus~~storages~~, said method comprising the steps of~~:~~,

executing at least one ~~or more of~~ of a plurality of application programs on ~~said~~ a first computer;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source,

wherein ~~and~~ said secondary storage ~~including~~ stores therein a plurality of storage units ~~(blocks)~~; ~~storing~~ which includes at least one ~~or more of~~ application data ~~(object)~~ used by said application programs ~~on said secondary storage~~; and

registering or deleting to/from said secondary storage apparatus an ~~a program module (~~object access module~~)~~ that implements an object-based I/O function by using a block-based I/O function.

4. (currently amended)A first computer according to claim 3, wherein~~:~~ said object access module obtains ~~the~~a data value or location of data in ~~the block~~ a storage unit corresponding to a specification, which is either an object, an object offset, an object offset size, or an object tag ~~(~~specifying the type of data to be retrieved~~)~~.

5. (currently amended)An object access module operable ~~with~~in a system including at ~~one or more of first~~a plurality of computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary ~~storages~~storage apparatus, said object access module comprising:

wherein a ~~said~~ first computer ~~executing~~ executes at least one ~~or more~~ of said application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source,

wherein said secondary storage ~~including~~ stores therein a plurality of storage units ~~(blocks), said secondary storage storing~~which includes at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus ~~providing~~ provides said first computer with a block-based I/O function and an object-based I/O function;

wherein said object access module ~~implementing~~ implements said object-based I/O function using block-based I/O function; and

wherein said object access module is sent from said first computer or a second computer different from said first computer to said secondary storage apparatus to cause said first or second computer to perform an object-based I/O request by executing said object access module~~to execute therein~~.

6. (currently amended)An object access module according to claims, wherein~~:~~ said object access module when executed obtains ~~the~~a data value or location of data in ~~the block~~a storage unit corresponding to a specification, which is either an object, an object offset, an object offset size, or an object tag ~~(~~specifying the type of data to be retrieved~~)~~.

7. (currently amended)A method for implementing an extensible network-attached secondary storage~~, operable with one or more of first~~in a system including a plurality of computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary ~~storages~~storage apparatus, said method comprising the ~~step~~steps of:

executing at least one ~~or more~~ of plurality of application programs on ~~said~~a first computer;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(~~secondary storage~~)~~ that can save data after shutting down of power source,

wherein said secondary storage ~~including~~ stores therein a plurality of storage units ~~(blocks); storing on said secondary storage one or more of~~ which include at least one application data ~~(object)~~ used by said application programs~~;~~,

wherein said secondary storage apparatus provides ~~providing for~~ said first computer a block-based I/O function and an object-based I/O function ~~from said secondary storage~~;

receiving, in said secondary storage apparatus from either the first computer or a second computer different from the first computer object description data indicating how ~~said object~~said application data is stored on said secondary storage ~~(object description data)~~; and

receiving, in said secondary storage apparatus from said first computer an ~~a request of~~ object-based I/O request for application data ~~on said object from said first computer to perform I/O of said~~and performing said object-based I/O request by identifying the location of said ~~object~~ application data on said secondary storage apparatus by using said object description data.

8. (currently amended)A method for implementing extensible network-attached secondary storage according to claim 7, wherein~~:~~ said object description data is data for specifying an attribute or an inter-block reference based on ~~the~~ an offset and size ~~thereof~~of said application data.

9. (currently amended)A method for implementing extensible network-attached secondary storage according to claim 7, wherein: said object description data is data for specifying an attribute or an inter-block reference by a lexical analyzing program ~~(parser)~~ or a parser generating grammar of said application data.

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10. (currently amended)A method for implementing extensible network-attached secondary storage according to claim 7, wherein: said object description data is data for specifying ~~the~~ a file format of said ~~object~~ application data based on whether the data stored in a specific part of one or more ~~blocks contains~~ storage units contain some specific value or pattern.

11. (currently amended)A computer operable ~~with one or more of first~~in a system including a plurality of computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary ~~storages~~storage apparatus, said computer comprising:

wherein a ~~said~~ first computer ~~executing~~ executes at least one ~~or more~~ of a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, and

wherein said secondary storage apparatus has stored therein ~~including~~ a plurality of storage units ~~(blocks), said secondary storage storing~~ including at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

wherein said computer register ~~registering~~ to or ~~deleting~~ delete from said secondary storage apparatus object description data indicating how said ~~object~~ application data is stored on said secondary storage apparatus~~(object description data)~~; and

wherein said secondary storage ~~providing~~ apparatus provides a block-based I/O function and an object-based I/O function to said first computer.

12. (currently amended)A computer according to claim 11, wherein~~:~~ said object description data is data for specifying ~~the~~a data sequence or an inter-block reference of data in a storage unit ~~block~~ based on ~~the~~ an offset and a size ~~thereof~~of said application data.

13. (currently amended)A computer according to claim 11, wherein~~:~~ said object description data is data for specifying an attribute or an inter-block reference of data in a ~~block~~ storage unit by a lexical analyzing program (parser) or a parser generating grammar of said application data.

14. (currently amended)A computer according to claim 11, wherein~~:~~ said object description data is data for specifying ~~the~~a file format of said ~~object~~ application

data based on whether ~~the~~ data stored in a specific part of one or more ~~blocks contains~~storage units contain some specific value or pattern.

15. (currently amended)A method for implementing extensible network-attached secondary storage, wherein~~:~~ said object access module when executed obtains ~~from~~ the object description data according to one of ~~claim~~ claims 7-14 ~~through claim 14 a method of storing objects in a secondary storage~~.

16. (currently amended)A first computer according to claim 3, wherein~~:~~ said object access module when executed obtains ~~from~~ the object description data according to one of ~~claim~~ claims 7-14 ~~through claim 14 a method of storing objects in a secondary storage~~.

17. (currently amended)An object access module according to claim 5, wherein~~:~~ said object access module when executed obtains ~~from~~ the object description data according to ~~claim~~ claims 7-14 ~~through claim 14 a method 10 of storing objects in a secondary storage~~.

18. (currently amended)A method for implementing an extensible network-attached secondary storage~~, operable with one or more of first~~in a system including a plurality of computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said method comprising the ~~step~~steps of:

executing at least one ~~or more~~ of plurality of application programs on ~~said~~a first computer;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source,

wherein said secondary storage ~~including~~ stores therein a plurality of storage units ~~(blocks);storing~~ including at least one ~~or more of~~ application data ~~(object)~~ used by said application programs ~~on said secondary storage~~;

wherein said secondary storage ~~being a secondary storage of a computer system for providing~~ provides a block-based I/O function and an advanced I/O function for application programs ~~(advanced I/O)~~ to said first computer~~, said secondary storage maintaining~~and maintains object access modules for implementing an object-based I/O function by using said block-based I/O function~~,~~;

receiving, in said secondary storage ~~receiving~~ from said first computer or a second computer different from said first computer, a module for implementing said advanced I/O function by using said object access module; ~~(function module) from said first computer or a second computer different from said first computer, then~~and

receiving, in said secondary storage ~~receiving~~ from said first computer, an~~a request for said~~ advanced I/O request ~~from said first computer to perform~~and performing said advanced I/O ~~of said~~ request by executing said ~~function~~ object access module.

19. (currently amended)A computer operable ~~with one or more of first~~in a system including a plurality of computers, at least one ~~or more of~~ secondary storage

apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary ~~storages~~apparatus, said computer comprising:

wherein a ~~said~~ first computer ~~executing~~ executes at least one ~~or more~~ of plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, ~~and~~

wherein said secondary storage ~~including~~ has stored therein a plurality of storage units ~~(blocks), said secondary storage storing in one or more of blocks~~ including at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus operating as said first computer or ~~said~~ as a second computer different from said first computer ~~running within a computer system for providing~~ provides to said first computer a block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

storing in said secondary storage apparatus ~~storing a~~an object access module that implements the object-based I/O function by using the block-based I/O function ~~(object access module)~~; and

~~said computer~~ registering to or deleting from said secondary storage apparatus a function module that implements said advanced I/O function by using said object access module ~~(function module)~~.

20. (currently amended)A program module operable in a system including a plurality of ~~with one or more of first~~ computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary ~~storages~~storage apparatus, said program module comprising:

~~said~~ wherein a first computer ~~executing~~ executes at least one ~~or more~~ of plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, ~~and~~

wherein said secondary storage ~~including~~ apparatus includes a plurality of storage units ~~(blocks), said secondary storage storing in one or more of blocks~~ which stores therein at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus ~~providing~~ provides said first computer with a block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

wherein said program module ~~being~~ is sent from said first computer or a second computer different from said first computer to said secondary storage apparatus to be executed thereinon ~~said secondary storage apparatus~~; and

wherein said program module ~~providing~~ provides said advanced I/O function by using ~~a~~ module ~~(object access module)~~ that implements the object-based I/O function by using the block-based I/O function.

21. (currently amended)A secondary storage apparatus ~~and~~having a protection module ~~thereon~~, operable in a system including a plurality of ~~with one or more of first~~ computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary ~~storages~~storage apparatus, said secondary storage apparatus comprising:

wherein said first computer ~~executing~~ executes at least one ~~or more of~~ a plurality of application programs;

~~said secondary storage apparatus including~~a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, ~~and~~

wherein said secondary storage apparatus ~~including~~ has stored therein a plurality of storage units ~~(blocks), said secondary storage storing in one or more of blocks~~ including at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus ~~providing~~ provides to said first computer a block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

wherein said secondary storage apparatus ~~maintaining a~~maintains an object access module that implements the object-based I/O function by using the block-based I/O function ~~(object access module)~~, and ~~as well as~~ a function module that implements said advanced I/O function by using said object access module ~~(function module)~~; and

wherein said protection module ~~determining~~ determines a method invocation to be allowed or denied when said function module attempts to invoke a method in the object access module.

22. (currently amended)A protection module according to claim 21, wherein~~:~~ said protection module is registered to or deleted from said secondary storage apparatus by said first computer or a second computer different from said first computer ~~running within said computer system~~.

23. (currently amended)A method for implementing an extensible network-attached secondary storage~~, operable with one or more of first~~ in a system including a plurality of computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said method comprising the ~~step~~steps of:

wherein said first computer ~~executing~~executes at least one ~~or more of~~ a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, ~~and~~

wherein said secondary storage apparatus has stored therein ~~including~~ a plurality of storage units ~~(blocks), said secondary storage storing in one or more of blocks~~ including at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus ~~providing~~ provides said first computer with a block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

wherein said secondary storage apparatus ~~maintaining~~ maintains an object access module that implements the object-based I/O function by using the block-based I/O function, ~~as well as~~and a function module that implements said advanced I/O function by using said object access module ~~(function module)~~;

~~said module (protection module) for~~ determining whether a method invocation is allowed or denied when said function module attempts to invoke a method in the object access module being received from said first computer or a second computer different from said first computer.

24. (currently amended) ~~A~~ computer operable in a system including a plurality of ~~with one or more of first~~ computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said computer comprising:

wherein said first computer ~~executing~~ executes at least one ~~or more~~ of a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, ~~and~~

wherein said secondary storage apparatus has stored therein ~~including~~ a plurality of storage units ~~(blocks), said secondary storage storing in one or more of~~

~~blocks~~ including at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus, operating as said first computer or said second computer different from said first computer, ~~running within a computer system for providing~~ provides to said first computer a block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

G4 wherein said secondary storage apparatus ~~storing~~ stores an object access module that implements the object-based I/O function by using the block-based I/O function, ~~as well as~~ and a function module that implements said advanced I/O function by using said object access module ~~(function module)~~;

wherein said computer ~~registering~~ registers to or ~~deleting~~ deletes from said secondary storage apparatus ~~said~~a protection module for determining a method invocation to be allowed or denied when said function module attempts to invoke a method in the object access module.

25. (original) A locking module on a secondary storage apparatus operable with one or more of first computers, one or more of secondary storage apparatus, and a network or I/O cable for connecting said first computers with said secondary storage apparatus, said module comprising:

said first computer executing one or more of application programs;

said secondary storage apparatus including storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks), said secondary storage storing

in one or more of blocks one or more of application data (object) used by said application programs;

said secondary storage apparatus providing said first computer with a block-based I/O function and an I/O function for said application programs (advanced I/O);

said secondary storage apparatus storing an object access module that implements object-based I/O function by using block-based I/O function;

when said object access module provides external devices a plurality of objects having containment, said locking module providing external devices with mutual exclusion function with the containment of said a plurality of objects being taken into consideration.

26. (original) A locking module according to claim 25, wherein:

said locking module is registered to or deleted from said secondary storage apparatus by said first computer or a second computer different from said first computer.

27. (original) A method for implementing extensible network-attached secondary storage, operable with one or more of first computers, one or more of secondary storage apparatus, and a network or I/O cable for connecting said first computers with said secondary storage apparatus, said method comprising the step of:

executing on said first computer one or more of application programs said secondary storage apparatus including storage medium (secondary storage) that

can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks), said secondary storage storing in one or more of blocks one or more of application data (object) used by said application programs;

providing from said secondary storage apparatus to said first computer with a block-based I/O function and an I/O function for said application programs (advanced I/O);

maintaining on said secondary storage apparatus an object access module that implements object-based I/O function by using block-based I/O function;

receiving locking module from said first computer or a second computer different from said first computer; when said object access module provides external devices a plurality of objects having containment, said locking module for providing external devices with mutual exclusion function with the containment of said a plurality of objects being taken into consideration.

28. (original) A computer operable with one or more of first computers, one or more of secondary storage apparatus, and a network or I/O cable for connecting said first computers with said secondary storage apparatus, said computer comprising:

said first computer executing one or more of application programs;

said secondary storage apparatus including storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks), said secondary storage storing

in one or more of blocks one or more of application data (object) used by said application programs;

said secondary storage apparatus operating as said first computer or said second computer different from said first computer running within a computer system for providing to said first computer a block-based I/O function and an I/O function for said application programs (advanced I/O);

said secondary storage apparatus storing an object access module that implements object-based I/O function by using block-based I/O function;

when said object access module provides external devices a plurality of objects having containment, said computer registering to or deleting from said secondary storage apparatus said locking module for providing external devices with mutual exclusion function with the containment of said plural objects being taken into consideration.

29. (original) A management computer operable with one or more of first computers, one or more of secondary storage apparatus, one second computer (a management computer), and a network or I/O cable for connecting said first computers and said second computer with said secondary storage apparatus, said management computer comprising:

said first computer executing one or more of application programs;

said second computer storing the list of said secondary storage apparatus;

said secondary storage apparatus including storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks);

said secondary storage apparatus provides said first computer with block-based I/O function and I/O function for said application programs (advanced I/O) or object-based I/O function;

said first computer sending to said second computer a protection module (module) that implements said advanced I/O;

said second computer receiving said module to send it to part or all of said secondary storage apparatus listed on the list;

said secondary storage apparatus receiving said module;

said first computer transmitting to said secondary storage apparatus a request of said advanced I/O;

said secondary storage apparatus invoking said module to perform said advanced I/O.

30. (original) A management computer according to claim 29, wherein:

said management computer provides a compiler for compiling said protection module for said secondary storage apparatus to compile said module received from said first computer using said compiler in order to send a compiled module to part or all of said secondary storage apparatus.

31. (original) A management computer according to claim 30, wherein:

said management computer storing model data of said secondary storage apparatus, provides one or more compilers for compiling modules for each model of said secondary storage apparatus, to compile said module received from said first computer using said one or more compilers for the destination secondary storage apparatus, to send a compiled module to part or all of said secondary storage apparatus.

32. (original) A method for implementing extensible network-attached secondary storage, operable with one or more of first computers, one or more of secondary storage apparatus, one second computer (a management computer), and a network or I/O cable for connecting said first computers and said second computer with said secondary storage apparatus, said management computer comprising:

said first computer executing one or more of application programs;

said second computer storing the list of said secondary storage apparatus;

said secondary storage apparatus including storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks);

said secondary storage apparatus provides said first computer with block-based I/O function and I/O function for said application programs (advanced I/O) or object-based I/O function;

said first computer sending to said second computer a protection module (module) that implements said advanced I/O;

said second computer receiving said module to send it to part or all of said secondary storage apparatus listed on the list;

said secondary storage apparatus receiving said module; said first computer transmitting to said secondary storage apparatus a request of said advanced I/O;

said secondary storage apparatus invoking said module to perform said advanced I/O.

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33. (original) A method for implementing extensible network-attached secondary storage, operable with one or more of first computers, one or more of secondary storage apparatus, and a network or I/O cable for connecting said first computers with said secondary storage apparatus, said method comprising the step of:

executing on said first computer one or more of application programs;

said secondary storage apparatus including storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks), said secondary storage storing in one or more of blocks one or more of application data (object) used by said application programs;

providing from said secondary storage apparatus to said first computer with a block-based I/O function and an I/O function for said application programs (advanced I/O) or object-based I/O function;

receiving a protection module (object access module) that implements said object-based I/O function or said advanced I/O by using block-based I/O function from said first computer or a second computer different from said first computer;

providing said secondary storage apparatus with a compiler for compiling said module into an executable for faster execution;

compiling said module using said compiler on said secondary storage apparatus;

receiving a request of object-based I/O or advanced I/O on said object from said first computer; and

performing I/O of said request by executing said compiled module.

34. (original) A method for implementing extensible network-attached secondary storage, operable with one or more of first computers, one or more of secondary storage apparatus, and a network or I/O cable for connecting said first computers with said secondary storage apparatus, said method comprising the step of:

executing on said first computer one or more of application programs;

said secondary storage apparatus including storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks), said secondary storage storing in one or more of blocks one or more of application data (object) used by said application programs;

providing from said secondary storage apparatus to said first computer with a block-based I/O function and an I/O function for said application programs (advanced I/O);

for said advanced I/O function, providing a feature of replying, in response to a request from said first computer, a correspondence between a plurality of part of one object and secondary storage apparatus for storing said part of object.

35. (original) An apparatus for implementing extensible network-attached secondary storage, operable with one or more of first computers, one or more of secondary storage apparatus, and a network or I/O cable for connecting said first computers with said secondary storage apparatus, said apparatus comprising:

said first computer executing one or more of application programs;

said secondary storage apparatus-including storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage including a plurality of storage units (blocks), said secondary storage storing in one or more of blocks one or more of application data (object) used by said application programs;

means for providing said first computer block-based I/O function and object-based I/O function;

means for receiving a program module (object access module) that implements object-based I/O function by using block-based I/O function from said first computer or a second computer different from said first computer;

means for receiving said object access module and for receiving a request of object-based I/O on said object access module from said first computer; and

means for executing said object access module.